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Adaptive Response of Children and Adolescents with Autism to the 2009 Earthquake in L'Aquila, Italy

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Abstract The literature offers no descriptions of the adaptive outcomes of people with autism spectrum disorder (ASD) after natural disasters. Aim of this study was to evaluate the adaptive behaviour of participants with ASD followed for 1 year after their exposure to the 2009 earthquake in L'Aquila (Italy) compared with an unexposed peer group with ASD, by administering the Italian form of the Vineland Adaptive Behaviour Scales (VABS) at baseline, 6 months and 1 year after the earthquake. Exposed participants declined dramatically in their adaptive behaviour during the first months after the earthquake ($p < 0.01$ for all VABS dimensions). However, immediate intensive post-disaster intervention allowed children and adolescents with autism showing a trend towards partial recovery of adaptive functioning.

Keywords Autism spectrum disorder · Post-traumatic stress disorder · Adaptive behaviour · Post-disaster adaptation · Intensive behavioural intervention · Resiliency

Introduction

While evaluating the health-related impact of natural disasters, special attention must be paid to individuals affected by psychiatric disorders, particularly autism spectrum disorders (ASD). Despite the substantial body of research linking stressful life events to the course of psychiatric diseases such as schizophrenia or affective/mood disorders (Horan et al. 2007; Fan et al. 2008), and the growing body of literature addressing the psychological sequelae of children and adolescents after natural disasters (Roussos et al. 2005; John et al. 2007), the literature completely lacks any descriptions of adaptive outcomes for people with ASD after natural disasters. This offers a special challenge to the scientific community. A recently published review evaluated the prevalence, assessment and treatment of post-traumatic stress disorder (PTSD) in people with intellectual disabilities (ID) (Mevisen and de Jongh 2010) and found that people with ID are at a greater risk of suffering from the disruptive effects of trauma, although experts in ID-related fields have limited awareness of PTSD and its disturbing effects on daily functioning. However, although the relationship between ASD and ID has been thoroughly discussed in the literature (Bradley et al. 2004), we could not find studies that specifically address the impact of natural disasters on the adaptation and daily life of people with ASD.

Life stressors rarely impact an entire population at the same time. Much to our regret, the occurrence of a disruptive earthquake provided an opportunity to explore the effects of a devastating natural disaster on a population with autism.

At 3:32 a.m. on April 6, 2009, a powerful earthquake measuring 6.3 on the Richter Scale struck the territory of L'Aquila, the capital city of the Abruzzo region of central

This work is dedicated to the memory of Dr. Michele Iavagnilio, caregiver of the Centre for Autism in L'Aquila, who died on April 6, 2009 in consequence of the earthquake.

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Italy. Three hundred eight people were confirmed dead and more than 1,500 were seriously injured, making it one of the most severe natural disasters in Italian history. It was the first earthquake in recent European history with an urban area of ancient historical importance as its epicentre. The earthquake spread about 5,000 km², left at least 55,000 of the city's 70,000 residents without housing, and destroyed the historical centre of the town, including a significant amount of economic activity and public services such as hospitals, outpatient and rehabilitation centres, and all grade schools. The Italian government reported official estimates of direct economic losses and reconstruction costs of eight billion euros.

The purpose of this study was to evaluate the intermediate- and long-term adaptive behaviour of participants with ASD for 1 year after their exposure to the L'Aquila earthquake, as compared with a group of young people with ASD who did not experience the earthquake. The *a priori* hypothesis of the study was that children and adolescents with autism exposed to the earthquake would show a clear decline in adaptive functioning over time with respect to both baseline and their unexposed peers.

Method

Design and Participants

We conducted a longitudinal study comparing the outcome of two groups of children and adolescents with autism, all treated within the rehabilitation programme established in the Abruzzo region of central Italy and described in a recent publication (Valenti et al. 2010). The first group included 18 participants who experienced the earthquake in L'Aquila on April 6, 2009. As reported by the families, no participants experienced extreme psychological exposures like remaining under the rubble, or having seen dead bodies, but all of them had to run away from home all of a sudden experiencing hard psychological and material deprivation in the very first hours after the main shock. The second (control) group included 42 participants living in Lanciano and Vasto, municipalities of the region that did not experience the earthquake in its disruptive manifestation.

Participants' Activities Before the Earthquake

All participants had attended semi-residential rehabilitation centres for autism in L'Aquila, Lanciano and Vasto since 2007. Inclusion criteria were an ASD diagnosis and regular attendance at public school, which is compulsory in Italy for children younger than 16 years of age. At the time of admission to the rehabilitation programme, all participants

had undergone standardised assessment with the Autism Diagnostic Observation Schedule (ADOS)—Italian version (Lord et al. 2005), whose modules are designed for individuals ranging in age from toddlerhood to adulthood and are suitable for both nonverbal and verbal individuals. The Italian version of the Autism Diagnostic Interview—Revised (ADI-R) (Rutter et al. 2005) was also administered, allowing parents or caregivers to answer a series of questions about the participant's behaviour. ASD diagnoses were made according to ADI-R and ADOS scores and ICD-10 criteria. ASD diagnoses included pervasive developmental disorder N.O.S. (three cases recorded); no cases of Asperger's disorder were recorded. Because intellectual disability and verbal ability can significantly impact the prognosis of individuals with ASD, both verbal and non-verbal IQ were assessed with the Wechsler Intelligence Scale for Children—III (WISC-III), Italian version (Wechsler 2006). Psychometric testing identified 43 out of 60 participants (71.6%) as having an intellectual disability (full scale IQs of 75 or lower).

In fact, the recruited cases represented almost 65% of all individuals with ASD younger than 18 years of age officially registered in the catchment area. Admission to the autism centres ultimately depended on the consent and desire of the participants' parents or tutors. No exclusion criteria were considered because by law the programme was open to all individuals younger than 18 years old with ASD. Participants were classified as children or adolescents on the basis of medically ascertained puberty. No child participants had taken psychoactive drugs at the time of their admission, while 12 adolescents were being treated with psychoactive drugs in order to control behavioural comorbidities such as impulsive-aggressive behaviour (10 participants), stereotypies (7 participants) and hyperactivity (6 participants). Four participants (one exposed, three unexposed to the earthquake) had experienced past traumatic exposures like divorce or loss of their parents or serious traffic accidents. No participants had previously experienced intensive behavioural intervention. All participants' parents (one or both, as appropriate) gave informed consent to admission and treatment and to the use of patient data for research purposes. Treatment was administered in accordance with the Helsinki Declaration and rules of good clinical practice and ethics in public mental health service and was officially approved and authorised by the local health agency.

Participants' Activities After the Earthquake

After April 6, 2009, the unexposed participants in Lanciano and Vasto continued their routine activities without interruptions, whereas the autism rehabilitation centre in L'Aquila was completely destroyed by the earthquake,

rehabilitation activities were interrupted and all exposed participants and their families were forced to find provisional housing. All of the patients' and families' routine activities of daily life were completely altered, with enormous material, psychological and social discomforts and hardships in the first days after the event. Approximately 2 weeks after the earthquake, the main local association of parents of persons with autism (Fondazione Il Cireneo) helped the families get provisional housing in another municipality in the Abruzzo region (Vasto, 170 km from L'Aquila) that offered a specialised rehabilitation centre and adapted school activities. Despite relatively good arrangements in hotels—at least compared with people who remained in L'Aquila and lived in field tents for months—and the availability of rehabilitation and health services, people with autism and their families were forced to adapt to completely new living conditions, with severely limited access to routine personal or family resources and radical changes in the school setting.

After 6 months (October 2009), all 18 participants who experienced the earthquake and their families had the opportunity to return to L'Aquila. Because many buildings were declared unfit for use indefinitely, most participants' families were assigned housing in new districts build on the outskirts of L'Aquila, exposing the participants with autism to further radical changes in daily routines. The school year started on October 2009 in prefabricated buildings, requiring environmental and situational modifications for participants with autism. At the same time, the activity of the L'Aquila autism centre restarted in prefabricated buildings, requiring participants and caregivers to adapt to the new setting. The construction of a new building is underway and should be completed in 2011.

Setting and Intervention

The rehabilitation setting and intervention within the Il Cireneo centres for autism in the Abruzzo region has been previously described (Valenti et al. 2010). Treatment is based on behaviour modification principles, though it cannot be regarded as pure applied behaviour analysis (ABA). ABA treatment focuses on the family and takes place at home; in our approach, intervention occurs primarily within the rehabilitation community: participants with autism are admitted to a specialised setting where their abilities are explored and reinforced, and an intervention programme is subsequently provided for home and school.

The centre intervention includes 3 h of treatment daily (from 3 p.m. to 6 p.m.), 5 days a week, with modules of up to 20 individuals divided by age group (children and teens). Two days per week are dedicated to inclusion in physical activities and sport programmes.

A defining feature of the intervention is that programmes are directed by professionals with advanced formal training in behaviour analysis and supervised experience in designing and implementing behavioural programming for learners with autism and related disorders. Centre activities are supervised by a senior child and adolescent psychiatrist and a senior psychologist widely experienced in the treatment of individuals with ASD.

Naturally, the activity conducted in the L'Aquila centre for autism after the earthquake reflects the limitations arising from changes in the specific setting (from a building to a prefab), the lives of the participants' families and caregivers, the overall precariousness of town services, including transport and social and family assistance, and the substantial decrease in economic activities that led to radical changes in average income and quality of life for most families.

Measures

The Italian form of the Vineland Adaptive Behaviour Scales (VABS) (Sparrow et al. 2008) was used to assess the adaptive functioning of exposed and non-exposed participants. Four VABS skill domains were used in this study: Communication (receptive, expressive, and written language skills), Daily Living (personal self-care, domestic living skills, and community living skills), Socialisation (interpersonal skills, play and leisure, and coping skills) and Motor Skills (gross and fine).

To ensure higher reliability, the VABS was administered to each participant's parent by the same professional at the three scheduled times. The first administration was March 2009, the end of the first 2 years of the rehabilitation programme. This was also the baseline measure for the present study because it was obtained only a few days before the earthquake. Subsequent administrations took place October 2009 (6 months after the earthquake) and April 2010 (1 year after the earthquake).

The VABS provides standard scores (mean = 100, SD = 15), and higher scores indicate better functioning. VABS scores can range from four standard deviations below the mean to more than two standard deviations above the mean in autistic individuals with and without comorbid mental retardation (Klin et al. 2007; MacLean et al. 1999). The importance of adaptive behaviour variability in autism is underscored by its strong contribution to prognosis (Gillham et al. 2003). Identifying sources of variability in adaptive behaviour is critical to obtaining a more complete picture of development in autism and identifying treatment targets (Mazefsky et al. 2008). All forms of the VABS can be used to measure the effectiveness of intervention strategies. VABS is sufficiently sensitive to test the effects of a treatment on several aspects of autism. The

VABS norms used for comparison with the sample where those for disabled individuals.

Data Analysis

The difference in VABS scores over time for the two groups (exposed vs. not exposed) was analysed according to a ‘one-within, one-between’ statistical design, using a MANOVA test for repeated measurements (Twisk 2003). The following effects were obtained: overall time effect (change over time in VABS scores for the total population), general group effect (difference in VABS scores between the compared groups) and group-by-time interaction effects (difference of change over time in VABS scores for the compared groups). All tests were two-tailed.

The intraclass correlation coefficient (Fleiss and Cohen 1973) was calculated as the reliability coefficient for each dimension of the VABS.

Results

Table 1 shows VABS scores at baseline and 6 months and 1 year after the earthquake. The MANOVA shows independent effects of exposure to earthquake, time, and interaction on all items.

Scores for the VABS communication domain in exposed group showed a significant decrease at 6 months after the event compared with unexposed peers.

It is worth noting that the 6-month score decrease is critical (nearly 20%) in exposed children and notable (nearly 10%) in exposed adolescents. At 1 year after the earthquake, the exposed children’s VABS scores rose again but remained significantly lower than baseline and those of unexposed participants, whereas the exposed adolescents’ VABS scores did not increase in the second semester of follow-up. The VABS scores for unexposed groups remained stable over time.

VABS Daily Living domain scores decreased significantly after 6 months in both exposed groups, nearly 15% in children and 25% in adolescents. In the following 6 months, Daily Living scores increased for exposed children and adolescents but remained far from both the baseline and the scores for unexposed participants, which remained stable during follow-up.

The disruptive effects of the earthquake emerged most clearly when socialisation scores were examined. In both children and adolescents, VABS Socialisation scores decreased dramatically (by 30%) 6 months after the earthquake. Socialisation scores rose again in the following 6 months but remained far below both baseline and the scores for the unexposed participants. VABS Socialisation

scores for the unexposed participants increased notably over time.

VABS Motor Skills scores were less affected than other VABS dimensions: the mean Motor Skills score decreased by only 10% in exposed participants after 6 months, and scores at 1 year after the earthquake were quite similar to the baseline. Consistently, scores for unexposed children remained stable, and scores for unexposed adolescents increased to above the standard mean value of the test (i.e., 100).

Intraclass correlation coefficients obtained for all VABS dimensions showed an overall good reliability.

Discussion

This study shows the adaptive response of children and adolescents with autism to the dramatic experience and aftermath of an earthquake. The literature presents strong evidence that children and adults in the general population experience PTSD after an earthquake (Roussos et al. 2005; Shannon et al. 1994; Goenjian et al. 1995; Jia et al. 2010) but completely lacks studies describing the ways that people with autism respond to a natural disaster. Indeed, this is the first study to address this area of interest. It included the majority of the children and adolescents with autism that were followed by a specialised centre in the exposed area and a comparison group of peers with autism followed in two nearby municipalities that were not directly affected by the earthquake.

Compared with studies conducted within the general population, for which self-report scales and psychometric scales based on DSM-IV PTSD criteria are available, no available diagnostic instruments specifically assess PTSD in individuals with ID or ASD. The presentation of PTSD is influenced by the degree and cause of ID, social circumstances, social and communication skills, the nature and timing of the traumatic experience and its subsequent management. The paucity of literature suggests that PTSD is frequently undiagnosed in individuals with ID and may be misattributed to other causes, with the risk of inappropriate interventions (Turk et al. 2005). There is great diversity of functional abilities among individuals with autism, and ASDs make up one of the largest diagnostic subgroups within the population of individuals with ID.

Little is known about autistic individuals’ responses to trauma, apart from case reports that focus more on abuse than exposure to disasters (Cook et al. 1993). Behavioural symptoms, such as self-injury (Tomasulo and Razza 2007), are presented as a symptom of PTSD in individuals with ID, but self-injurious behaviour is a well-known and common sign of ASD, so it cannot be regarded to as a

Table 1 VABS scores at baseline, 6 months after the earthquake and 1 year after the earthquake

	Time	Children		Adolescents	
		Exposed <i>N</i> = 9 Mean (SD)	Not exposed <i>N</i> = 20 Mean (SD)	Exposed <i>N</i> = 9 Mean (SD)	Not exposed <i>N</i> = 22 Mean (SD)
Communication	Baseline	86.9 (13.4)	87.5 (10.4)	77.9 (12.4)	78.3 (9.7)
	6 months	70.3 (14.4)	85.4 (9.6)	70.7 (11.1)	76.5 (8.7)
	1 year	78.9 (13.6)	86.6 (10.1)	69.8 (12.4)	82.3 (10.2)
MANOVA (Wilks' Λ ; <i>F</i> ; <i>p</i>)		0.17; 40.52; <i>p</i> < 0.01		0.29; 21.74; <i>p</i> < 0.01	
Exposure effect		0.01; 577.44; <i>p</i> < 0.01		0.01; 625.2; <i>p</i> < 0.01	
Time effect		0.17; 62.06; <i>p</i> < 0.01		0.29; 33.82; <i>p</i> < 0.01	
Exposure \times time effect					
ICC = 0.85					
Daily living	Baseline	79.7 (9.2)	82.8 (7.6)	87.3 (5.2)	89.4 (7.5)
	6 months	67.1 (8.0)	87.0 (7.7)	65.3 (10.3)	88.3 (10.0)
	1 year	70.2 (9.5)	85.5 (5.0)	72.5 (5.5)	89.6 (6.8)
MANOVA (Wilks' Λ ; <i>F</i> ; <i>p</i>)		0.04; 176.66; <i>p</i> < 0.01		0.08; 103.65; <i>p</i> < 0.01	
Exposure effect		0.01; 1,040.79; <i>p</i> < 0.01		0.00; 3,818.98; <i>p</i> < 0.01	
Time effect		0.08; 145.40; <i>p</i> < 0.01		0.08; 159.76; <i>p</i> < 0.01	
Exposure \times time effect					
ICC = 0.68					
Socialisation	Baseline	80.2 (6.2)	77.4 (6.7)	82.5 (7.0)	77.8 (6.9)
	6 months	56.5 (3.6)	77.5 (9.0)	58.8 (5.2)	79.4 (7.5)
	1 year	65.6 (4.6)	82.0 (6.7)	71.3 (5.8)	83.6 (7.0)
MANOVA (Wilks' Λ ; <i>F</i> ; <i>p</i>)		0.06; 128.74; <i>p</i> < 0.01		0.02; 295.79; <i>p</i> < 0.01	
Exposure effect		0.00; 2,481.15; <i>p</i> < 0.01		0.00; 1,503.63; <i>p</i> < 0.01	
Time effect		0.06; 196.77; <i>p</i> < 0.01		0.03; 450.64; <i>p</i> < 0.01	
Exposure \times time effect					
ICC = 0.47					
Motor skills	Baseline	93.7 (5.7)	93.0 (9.7)	94.7 (6.4)	98.3 (8.6)
	6 months	84.2 (7.3)	100.4 (7.3)	83.4 (6.9)	100.9 (5.2)
	1 year	94.4 (6.8)	99.5 (7.6)	89.8 (7.8)	106.0 (15.3)
MANOVA (Wilks' Λ ; <i>F</i> ; <i>p</i>)		0.06; 121.40; <i>p</i> < 0.01		0.11; 70.38; <i>p</i> < 0.01	
Exposure effect		0.00; 1,855.82; <i>p</i> < 0.01		0.00; 4,239.60; <i>p</i> < 0.01	
Time effect		0.07; 167.54; <i>p</i> < 0.01		0.13; 87.41; <i>p</i> < 0.01	
Exposure \times time effect					
ICC = 0.71					

Exposed: 18 subjects with ASD who were exposed to the earthquake

Controls: 42 subjects with ASD who were not exposed to the earthquake

Baseline assessment: March 2009

specific indicator of post-traumatic distress in most people with ASD and a history of self-aggression.

Facing these methodological issues, we decided to focus our attention on adaptive behaviour rather than symptoms by using the VABS survey form, a well-recognised instrument with demonstrable reliability and validity on both typically developing individuals and those with disabilities. It is also the prominent measure for assessing adaptive functioning in children with autism (Newsom and Hovanitz 1997). Previous research has found that children

with autism present a characteristic pattern of adaptive behaviour, as measured by the VABS (deficits in the Socialisation domain, relative deficits in the Communication domain, and relative strengths in the Daily Living domain) (Fenton et al. 2003).

Our results clearly demonstrate that the adaptive behaviour of children and adolescents with autism declined dramatically in the first months after an earthquake. The decrease in VABS scores was statistically and clinically significant in all the dimensions examined (i.e.,

communication, daily living, socialisation and motor skills, though some differences were found between children and adolescents). The disruptive impact of exposure to an earthquake is clearly shown by the comparison of VABS socialisation scores for the exposed and unexposed participants: exposed participants showed a 30% decrease after 6 months compared with the baseline and a score 15% lower than the baseline after 1 year of follow-up. These results clearly reflect the dramatic life changes facing the participants and their families, who since April 2009 have faced uncertainty about their housing, work, health services, environment and social relationships. Families' relocation to the newly built outskirts of the town entailed a radical change in the network of services and relationships previously available to individuals with autism.

Of course, our study suffers from some limitations. A partial one is the relatively small sample of subgroups of exposed participants, although it should be kept in mind that the fewer factors included in a design, the more power it will have to detect significant effects. Because MANOVA for repeated measurements is basically a testing technique, *p* values were used to evaluate longitudinal relationships. An important weakness of our study is that it fails in describing the earthquake impact on caregivers and interventionists. What we do know about the impact of trauma in children is that response to traumatic events are mediated by caregivers and significant others in the child's life, so that what we may be seeing may be an artifact of impaired caregiver functioning: this is an important goal for future research. A further potential limitation of the study lies with the use of parental responses to assess participants' adaptive behaviour changes: because both parents and professionals contributed to the intervention, both are prone to bias (in either direction). Another potential weakness of the study design is not having a control group from a location farther than the control cities of Lanciano and Vasto, which are only 170 km from the epicentre: for an earthquake of 6.3 degrees on the Richter scale, this distance is difficult to classify them as "not affected". Indeed, even the children in most distant cities are somewhat exposed to the psychological impact of the disaster through the TV screens, and their fellowship feelings with the children in the disaster affected regions.

Our results demonstrate that after a partial throwback to relatively stable life conditions and immediate, intensive interventions after the disaster, children and adolescents with autism showed a clear tendency to recover their adaptive functioning, although a complete recovery likely will take a longer time. This finding is encouraging for persons with autism and their families and caregivers, and indicates that not all is lost after a disaster, even in objectively hard conditions: people with autism can

struggle through emergencies and disruptive changes, gathering strength from unexplored or unexpected psychological resources.

In conclusion, if recognition of and early intervention for mental health issues can ameliorate the negative psychological effects of disasters on children and adolescents in the general population (Baren et al. 2008), the same must be assumed for children and adolescents with ASD.

Past traumatic exposures are important in moderating the impact of the current disaster (Wolmer et al. 2005): however, only four out of 60 participants had a definite history of past trauma, so that such hypothesis cannot be supported by sound data analysis from our study.

People with pre-existing health problems, particularly people with special needs (such as autism), suffer very much from disasters: however, further studies are required, controlling people with autism with typically developing in order to determine any disproportionate change specific to the diagnosis and commensurate to the severity of autism. Our study demonstrates that resiliency and the recovery of pre-disaster functioning in youngsters with autism largely depends on their immediate inclusion in routine, intensive rehabilitation programmes and the steadying, as far as possible, of daily life routines. Public health services may consider collaborating with community partners, families and health services providers to improve post-disaster coping in people with ASD (Eisenman et al. 2009). Overall, while considering our findings as preliminary, we strongly recommend further research in this understudied area of interest.

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